Nov. 2, 1954 B. P. BAKER ET AL 2,693,519

CIRCUIT INTERRUPTER

Filed July 15, 1950 2 Sheets-Sheet 1

Fig.1.

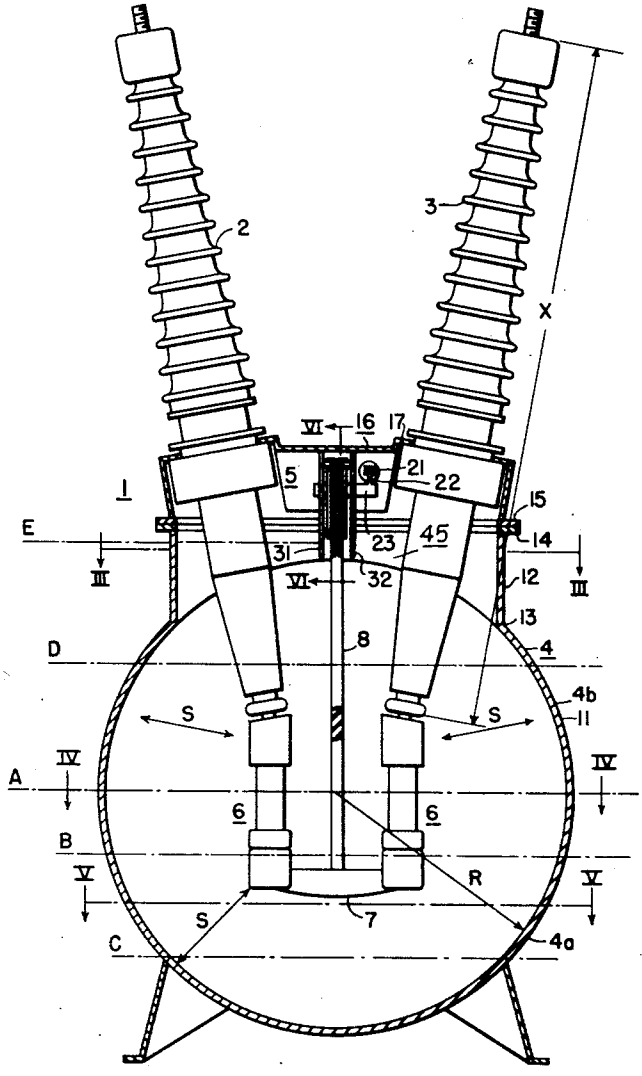
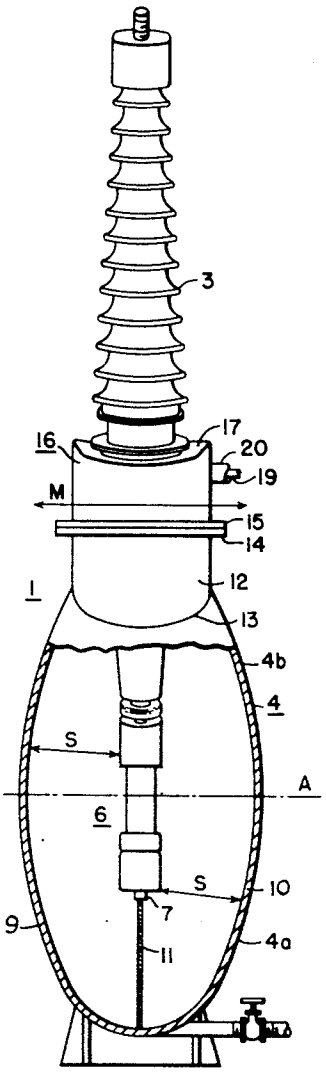


Fig.2.



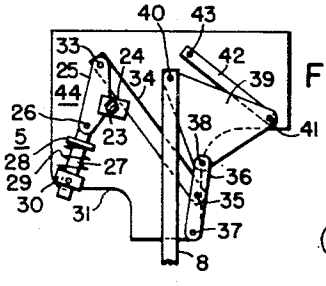


Fig.6.

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Fig. 3.

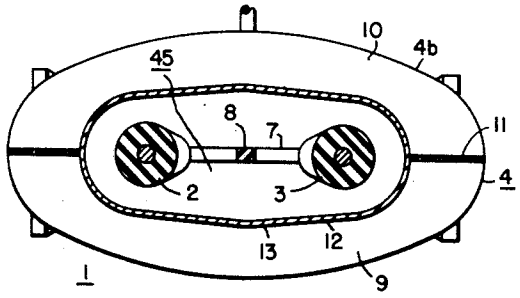


Fig. 4.

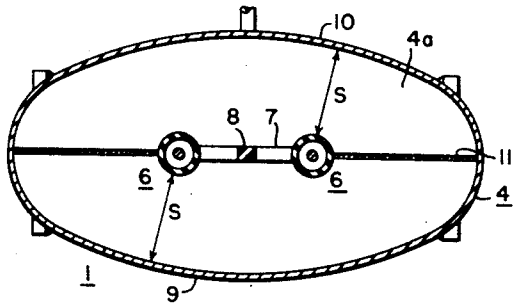
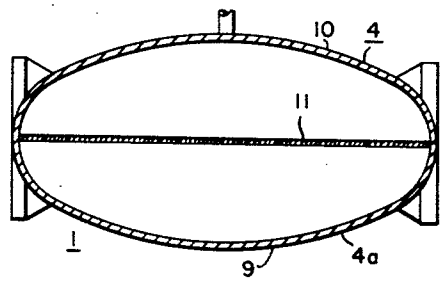


Fig. 5.



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CIRCUIT INTERRUPTER

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Application July 15, 1950, Serial No. 174,107

20 Claims. (Cl. 200—150)

This invention relates to circuit interrupters in general, and more particularly to circuit interrupter tank configurations, and to circuit interrupter mounting arrangements.

In United States patent application Serial No. 624,284, filed October 24, 1945, now U. S. Patent 2,581,571, issued January 8, 1952, to Benjamin P. Baker and Oswald von Mehren, and assigned to the assignee of the instant application, there is disclosed and claimed features of a spherical tank construction utilized in a compressed gas circuit interrupter. A general object of our invention is to provide an improved circuit interrupter, such that the tank will have advantages over the tank construction disclosed in the aforesaid patent, by having a minimum fluid volume, minimum electrical clearances, and yet will be mechanically strong and economical to fabricate.

Another object is to provide an improved tank configuration, particularly suitable for liquid type breakers, in which the electrical clearances between the interrupting units and the grounded tank walls will be adequate, and yet the liquid volume enclosed by the tank will be a minimum. By having less liquid volume, the cost of the liquid within the breaker will be reduced, and the cost of handling and periodically filtering the liquid will be diminished.

Still a further object is to provide an improved tank configuration utilizing in the fabrication thereof easily workable and commercially obtainable parts.

Another object is to provide an improved circuit interrupter with improved means for mounting the terminal bushings.

Further objects and advantages will readily become apparent upon reading the following specification, taken in conjunction with the drawings, in which:

Figure 1 is a side-elevational view, partially in vertical section, of an improved tank construction embodying our invention, the arc-extinguishing units being shown in the closed circuit position;

Fig. 2 is an end elevational view, partially in vertical section, of the interrupter illustrated in Fig. 1;

Figs. 3–5 are views, in section, taken along the lines III—III, IV—IV and V—V of Fig. 1, looking in the direction of the arrows; and

Fig. 6 is an enlarged fragmentary sectional view taken along the line VI—VI of Fig. 1, looking in the direction of the arrows.

Referring to the drawings, and more particularly to Fig. 1 thereof, the reference character **1** generally designates a circuit interrupter, particularly one of the liquid break type, including a pair of terminal bushings **2**, **3** extending interiorly within a tank structure **4**.

Depending from the lower ends of the terminal bushings **2**, **3** are a pair of identical arc-extinguishing units, generally designated by the reference numeral **6**, and electrically interconnected, in the closed circuit position shown in Fig. 1, by a conducting bridging member **7**, actuated vertically, in a reciprocal manner, by an insulating lift rod **8**. The lift rod **8** is actuated by a leverage mechanism **5**, driven by a horizontally reciprocally movable pull rod **19**. The pull rod **19** is shielded by a tube **20**, more clearly shown in Fig. 2.

The end of the pull rod **19** is bifurcated, as at **21**, and is pivotally connected to the crank arm **22** integrally formed with an operating shaft **23** (Fig. 6). Rotatable with the shaft **23** is a plate **24**, to which is welded a toggle link **25**. A knee-pin **26** pivotally interconnects the toggle link **25** with a cooperating toggle link **27**. A

spring seat **28** is fixed, as by welding, to the toggle link **27**. A compression spring **29** surrounds the toggle link **27**, being interposed between the spring seat **28** and an apertured spring seat **30**. The spring seat **30** is stationarily pivotally mounted between a pair of support plates **31**, **32**, the latter being fixed, as by welding, to a head **17** of the interrupter **1**. The support plates **31**, **32** also serve to journal the operating shaft **23**.

The upper end of the toggle link **25** is pivotally connected, as at **33**, to a link **34**, the lower end of which is pivotally connected, as at **35**, to a lever **36**, the lower end of which is stationarily pivoted on a pin **37** extending between the two support plates **31**, **32**.

The upper end of the lever **36** is pivotally connected, as at **38**, to a triangularly-shaped actuating plate **39**. A moving pivot **40** interconnects the insulating lift rod **8** with the actuating plate **39**, suitable guide means, not shown, being utilized to assist in guiding the vertical reciprocal motion of the lift rod **8**.

The actuating plate **39** is also pivotally connected, as at **41**, to a lever **42**, the upper end of which is stationarily pivotally mounted, as at **43**, between the two support plates **31**, **32**.

The operation of the leverage mechanism **5** will now be described. To effect an opening operation of the interrupter, from the closed circuit position thereof, as shown in Figs. 1 and 2, the pull rod **19** is moved toward the right, as viewed in Fig. 2, by any suitable mechanism, which forms no part of our invention. The rightward movement of the pull rod **19**, as viewed in Fig. 2, effects clockwise rotative motion of the operating shaft **23**, which breaks the toggle **44**, comprising the two toggle links **25**, **27**, being assisted by the spring force **29**. The breaking of the toggle **44** forces link **34** diagonally downwardly to rotate the lever **36** in a clockwise direction about the stationary pivot **37** to effect counterclockwise rotation of the triangularly-shaped actuating plate **39**, to thereby cause downward opening motion of the insulating lift rod **8**. The lever **42** swings slightly upwardly in a counterclockwise direction about the stationary pivot **43** during this opening motion.

The downward opening motion of the lift rod **8** correspondingly effects downward opening motion of the conducting bridging member **7** to thereby effect opening of the contact structure within the units **6** to effect breaking of the circuit therein. Continued downward movement of the lift rod **8** and the conducting bridge **7** effects two isolating gaps in the circuit, as well known by those skilled in the art.

For a description of the manner of the interrupting of the arcs within the units **6**, reference may be had to U. S. Patent 2,462,733, issued February 22, 1949, to Gilbert J. Easley, entitled "Circuit Interrupter," and assigned to the assignee of the instant application. This patent, in Fig. 2 thereof, shows the general arrangement of the sequential contact construction which may be utilized in the arc-extinguishing units **6**, but which forms no part of our invention, and consequently is not described.

Our invention is, in part, particularly concerned with the configuration or shape of the tank **4**. As shown more clearly in Figs. 1 and 2, it will be noted that the body portion of the tank **4** is preferably formed from a pair of circular semi-elliptical or oval-shaped dished heads **9**, **10** welded along the seam **11**. The resulting construction is such that sections taken therethrough, as indicated by Figs. 4 and 5, are of elliptic or oval shape. Such a construction gives a minimum liquid volume, which reduces the initial and maintenance costs of the breaker, and yet lends itself readily to having great mechanical strength. Moreover, it will be observed that the electrical clearances interiorly of the tank **4**, between the live parts of the units **6** and the interior walls of the grounded tank **4** are adequate.

To support the terminal bushings **2** and **3** within the tank **4**, we weld an upstanding elliptically or oval-shaped cylinder, or extension **12** to a cut-out portion **13** of the body portion of the tank **4**. Preferably the upper end of the cylinder **12** has a flange **14**, which cooperates with a flange **15** provided at the lower end of a sub-assembly **16** including the terminal bushings **2**, **3** and the metallic

third head 17. The cylinder 12 and head 17 collectively constitute a housing means disposed at the top of the body portion of the tank 4 and serve to support the two terminal bushings 2, 3.

Thus, the tank 4 includes a lower portion, below the plane "A," which may be designated by the reference character 4*a*, and an upper extended portion above the plane "A" which may be designated by the reference character 4*b*. The extension 4*b*, including the oval cylindrical part 12, carries the bushings 2, 3 and permits the use of longer bushings for higher-voltage service without increasing the size or volume of the lower portion 4*a* of the tank, it being noted that the bushings have a length "X" which, as seen in Fig. 1, is greater than twice the radius "R" of the lower portion 4*a* of the tank 4.

Preferably the terminal bushings 2, 3 are of the condenser type so that the operating mechanism 5, being adjacent the mid-portion of the terminal bushings 2, 3, is only adjacent surfaces which are at substantially ground potential.

It will be observed that horizontal sections taken through the tank 4 on the planes B, C, D or E are of oval configuration. Also the cylindrical member 12, being of oval or elliptical shape, is long in one horizontal direction, that is the direction from right to left in the plane of the showing of Fig. 1, to accommodate the terminal bushings 2, 3, with a space 45 therebetween to accommodate the leverage mechanism 5. The cross-section through the cylindrical member 12 is narrow in the other horizontal direction, that is along the line M (Fig. 2) adjacent the two terminal bushings 2, 3, being at these points only slightly wider than the terminal bushings 2, 3.

From the foregoing it will be apparent that the configuration of the tank 4 is such as to hold a minimum of fluid, and yet to have adequate electrical clearances between the live parts of the interrupter, at the lower interior ends of the terminal bushings 2, 3, and the grounded walls of the tank 4.

In assembling the interrupter, the two terminal bushings 2 and 3 are secured to the head 17, and then the arc extinguishing units 6 are threadedly secured and clamped into place at the lower ends of the bushings 2, 3. The sub-assembly 16 is then lowered into the tank 4, so that the flanges 14, 15 may be rigidly held together by suitable nuts and bolts, not shown.

It will be noted that the configuration of the tank 4 with respect to the interrupting units 6 is such that substantially all of the surface elements of the tank 4 are spaced the minimum distance away from the units 6 to prevent flash-over therebetween. In other words, considering the distance "S" in Fig. 4 as the minimum disance which will prevent flash-over between the live parts of the units 6 and the interior surface of the grounded tank 4, it will be noted that the distance "S" is substantially preserved between the units 6 and the interior walls of the grounded tank 4. Thus, the envelope of the tank 4 is such as to provide only enough clearance between the interior walls of said tank 4 and the units 6 to prevent breakdown for the voltage considered. The result of such a construction is that the volume enclosed by the tank 4 is a minimum, and yet the surface elements of the tank or envelope 4 are spaced only the minimum distance from the units 6 and the conducting bridging member 7 to prevent flash-over therebetween.

From the foregoing description of our invention, it will be apparent that we have provided an improved tank configuration particularly adapted for liquid-break types of circuit interrupters. However, if desired, the construction could be utilized in a compressed air interrupter having the tank 4 pressurized, as disclosed in the aforesaid United States patent.

It will be observed that the tank 4 is simple and economical to fabricate. It will moreover be noted that the circular semi-elliptical or oval-dished heads 9, 10 are readily available commercially. The resulting structure is strong, and utilizes a minimum volume of liquid or other fluid.

Although we have shown and described a specific structure, it is to be clearly understood that the same was merely for the purpose of illustration, and that changes and modifications may readily be made therein by those skilled in the art, without departing from the spirit and scope of the appended claims.

We claim as our invention:

1. A circuit interrupter construction having two circular substantially semi-elliptical dished heads secured together by a substantially vertical single seam to form a tank, and a pair of terminal bushings extending within the tank at the upper end thereof.

2. A circuit interrupter tank of generally circular side elevational shape, horizontal sections through which are of substantially elliptic configuration with rounded ends, and at least one arc-extinguishing unit disposed therewithin.

3. A circuit interrupter construction having two dished heads secured together by a substantially vertical single seam, an upstanding oval cylindrical member at the top thereof, and a pair of terminal bushings extending through the oval cylindrical member.

4. A circuit interrupter construction having two substantially semi-elliptical dished heads secured together by a single seam, an upstanding oval cylindrical member thereon, a third head, a pair of terminal bushings secured to the third head, and the third head being secured to the outer end of the oval cylindrical member.

5. A circuit interrupter including a fixed tank of constant volume, means supporting the fixed tank adjacent the lower end thereof, two terminal bushings extending into the tank adjacent the upper end thereof, said tank having its lower half generally semi-circular in cross section taken in a vertical plane extending through the tank and through the two terminal bushings, horizontal sections taken through the lower half of the tank being of oval shape with rounded ends, said tank having extended housing means at its upper end for receiving the two terminal bushings, and the cross-sectional area of said extended housing means taken on a horizontal plane being smaller than the cross-sectional area through the mid-portion of the tank taken on a horizontal plane.

6. A circuit interrupter including a fixed tank of constant volume, means supporting the fixed tank adjacent the lower end thereof, two terminal bushings extending into the tank adjacent the upper end thereof and having their lower interior ends extending adjacent the mid-portion of the tank, said tank having its lower half generally semi-circular in cross section taken in a vertical plane extending through the tank and through the two terminal bushings, arc extinguishing units supported at the interior ends of the terminal bushings adjacent the portion of the tank of greatest cross-section area taken on a horizontal plane, horizontal sections taken through the lower half of said tank being of oval configuration with rounded ends, said tank having an extended portion at its upper end for receiving the two terminal bushings, the cross-sectional area of said extended portion taken on a horizontal plane being smaller than the cross-sectional area through the mid-portion of the tank taken on a horizontal plane, an operating mechanism, and said extension at the top portion of the tank having a cross section which is long in one horizontal direction to receive the two terminal bushings with a space therebetween for the operating mechanism and which is narrow in the other horizontal direction adjacent the two terminal bushings, being at these points only slightly wider than the terminal bushings.

7. A circuit interrupter including a fixed tank of constant volume, means supporting the fixed tank adjacent the lower end thereof, two terminal bushings extending into the tank adjacent the upper end thereof, said tank having its lower half generally semi-circular in cross section taken in a vertical plane extending through the tank and through the two terminal bushings, horizontal sections taken through the lower half of said tank being of oval configuration with rounded ends, said tank having an extended portion at its upper end for receiving the two terminal bushings, the cross-sectional area of said extended portion taken on a horizontal plane being smaller than the cross-sectional area through the mid-portion of the tank taken on a horizontal plane, and the radius of the semi-circular lower portion of the tank being less than half the length of the terminal bushings.

8. A circuit interrupter including a fixed tank of constant volume, means supporting the fixed tank adjacent the lower end thereof, two terminal bushings extending into the tank adjacent the upper end thereof and having their lower interior ends extending adjacent the mid-portion of the tank, said tank having its lower half generally semi-circular in cross section taken in a vertical plane extending through the tank and through the two terminal

bushings, arc extinguishing units supported at the interior ends of the terminal bushings adjacent the portion of the tank of greatest cross-sectional area taken on a horizontal plane, horizontal sections taken through the lower half of the tank being of oval configuration with rounded ends, said tank having an extended portion at its upper end for reeciving the two terminal bushings, an operating mechanism, the cross-sectional area of said extended portion taken on a horizontal plane being smaller than the cross-sectional area through the mid-portion of the tank taken on a horizontal plane, said extension at the top portion of the tank having a cross section which is long in one horizontal direction to receive the two terminal bushings with a space therebetween for the operating mechanism and which is narrow in the other horizontal direction adjacent the two terminal bushings, being at these points only slightly wider than the terminal bushings, and the radius of the semi-circular lower portion of the tank being less than half the length of the terminal bushings.

9. A circuit interrupter tank construction resulting from securing two circular dished heads together by a single seam, horizontal sections through which are of oval configuration with rounded ends, and a pair of terminal bushings extending within the tank.

10. A circuit interrupter tank of circular side elevational shape, horizontal sections through which are of oval configuration with rounded ends, and at least one arc-extinguishing unit disposed therewithin.

11. A circuit interrupter tank construction resulting from securing two dished heads together by a single seam, horizontal sections through which are of oval configuration with rounded ends, an upstanding cylindrical member, and a pair of terminal bushings extending through the cylindrical member.

12. A circuit interrupter tank construction resulting from securing two dished heads together by a single seam, horizontal sections through which are of oval configuration with rounded ends, an upstanding cylindrical member, horizontal sections through which are also of oval configuration, and a pair of terminal bushings extending through and being supported by the cylindrical member.

13. A circuit interrupter tank constuction resulting from securing two dished heads together by a single seam, horizontal sections through which are of oval configuration with rounded ends, an upstanding cylindrical member, horizontal sections through which are also of oval configuration, a third head, a pair of terminal bushings secured to the third head, and the third head being secured to the outer end of the cylindrical member.

14. A circuit interrupter tank construction resulting from securing two dished heads together by a single seam, horizontal sections through which are of oval configuration, a pair of terminal bushings extending within the tank, and the radius of the lower half of the tank taken in a vertical plane extending through the tank and also through the terminal bushings being less than half the length of the terminal bushings.

15. A circuit interrupter tank construction resulting from securing two dished heads together by a single seam, horizontal sections through which are of oval configuration, upstanding housing means at the top of said dished heads, a pair of terminal bushings extending through the upstanding housing means, and the radius of the lower half of the tank taken in a vertical plane extending through the tank and through the two terminal bushings being less than half the length of the terminal bushings.

16. A circuit interrupter tank construction resulting from securing two dished heads together by a single seam, horizontal sections through which are of oval configuration, an upstanding cylindrical member, horizontal sections through which are also of oval configuration, a

pair of terminal bushings extending through the cylindrical member and having their lower ends disposed adjacent the mid-portion of the tank, an operating mechanism, and a space within the cylindrical member between the two terminal bushings for accommodating the operating mechanism.

17. A circuit interrupter including a tank, a pair of terminal bushings extending into the tank adjacent the upper portion thereof, means mounting the tank adjacent the lower end thereof, the body portion of the tank being generally circular when viewed in side elevation, a cylindrical portion extending generally upwardly from the circular body portion to support at least one terminal bushing adjacent the mid-portion thereof, and horizontal sections taken through the body portion of the tank being generally elliptical with rounded ends.

18. The combination in a liquid-break circuit interrupter of a tank having a body portion of generally circular shape when viewed in side elevation, a pair of terminal bushings converging inwardly and extending into the body portion of the tank from the uper end thereof, housing means extending upwardly from the body portion of the tank to support the terminal bushings adjacent the mid-portion thereof, and horizontal sections taken through the body portion of the tank being generally elliptical with rounded ends.

19. A circuit interrupter including a tank, a pair of terminal bushings extending into the tank adjacent the upper portion thereof, means mounting the tank adjacent the lower end thereof, the body portion of the tank being generally circular when viewed in side elevation, housing means extending generally upwardly from the circular body portion to support the terminal bushings adjacent the mid-portion thereof, horizontal sections taken through the body portion of the tank being generally elliptical with rounded ends, and the radius of the body portion of the tank being less than half the length of the terminal bushing.

20. The combination in a liquid-break circuit interrupter of a tank having a body portion of generally circular shape when viewed in side elevation, a pair of terminal bushings converging inwardly and extending into the body portion of the tank from the upper end thereof, upwardly extending housing means at the top of the body portion of the tank and supporting each of the terminal bushings adjacent the mid-portion thereof, horizontal sections taken through the body portion of the tank being generally elliptical with rounded ends, and the radius of the body portion of the tank being less than half the length of the terminal bushing.

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